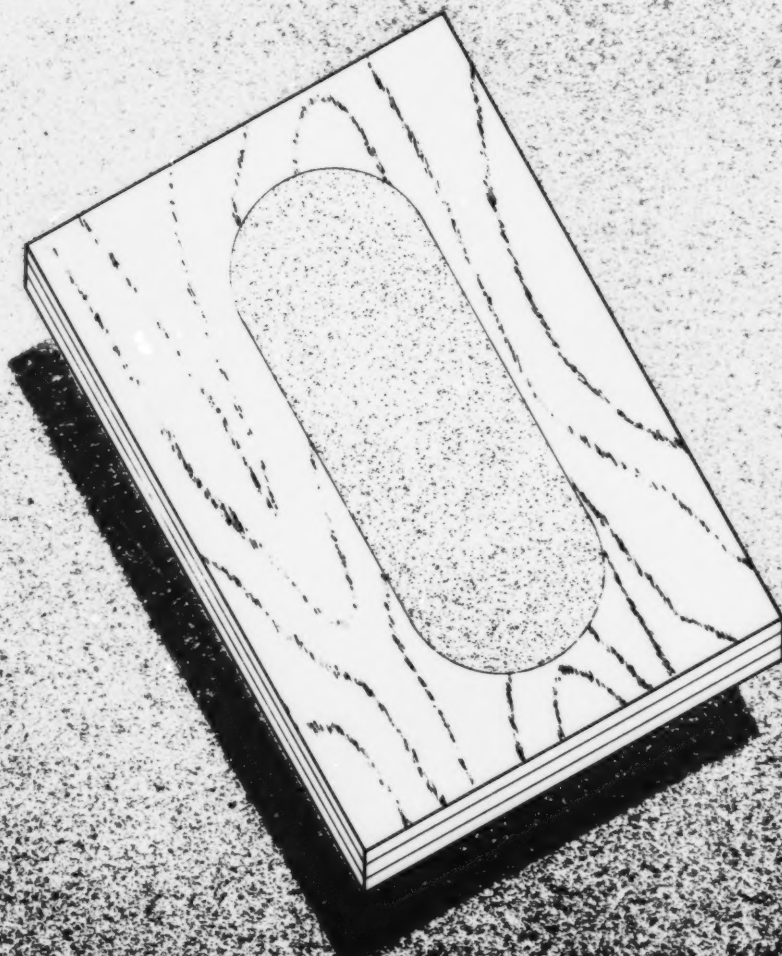


Evaluation Procedures for Synthetic Patching Materials for Repairs to Plywood Panels

W. V. Hancock

P. R. Steiner



87-01069/

**EVALUATION PROCEDURES FOR SYNTHETIC PATCHING
MATERIALS FOR REPAIRS TO PLYWOOD PANELS**

by

**W.V. Hancock
P.R. Steiner**

SP - 18R

Replaces Information Report VP-X-131

ISSN 0824 - 2119

**This report was originally
published by the Western Forest
Products Laboratory of the
Canadian Forestry Service,
Department of the Environment.
It is reprinted by Forintek
Canada Corp. with their
permission.**

**Forintek Canada Corp.
Western Laboratory
6620 N.W. Marine Drive
Vancouver, B.C.
V6T 1X2**

December 1986



ABSTRACT

Plywood panels that are being produced to meet the requirements of CSA 0121M-1978 Douglas-fir Plywood, or of CSA 0151M-1978 Canadian Softwood Plywood, may be repaired with synthetic patching materials within the limits set by the pertinent standard. The standards require that materials used for the purpose shall meet each of the tests described herein.

KEY WORDS: Douglas-fir plywood; Canadian softwood plywood; synthetic patching materials.

RESUMÉ

Les panneaux de contreplaqués, fabriqués pour rencontrer les spécifications du Contreplaqué du Sapin de Douglas 0121M-1978 de l'ACBR, ou du Contreplaqué résineux du Canada 0151M-1978 de l'ACBR, peuvent être réparés avec du matériel à rapiécer synthétique selon les limites établies par la norme pertinente. Les normes exigent que les matériaux ainsi utilisés se conforment aux exigences de chacun des essais décrits ici.

MOTS-CLES: contreplaqué de Sapin de Douglas; contreplaqué de résineux Canadiens; matériaux à rapiécer synthétiques.

INTRODUCTION

The repair of small, open defects in plywood panels is usually effected by the application of a filler, generally composed of resinous, polymeric plastic dissolved in a solvent and incorporating organic and/or inorganic extender materials and pigments. These materials, which harden by solvent evaporation, have proven their worth, particularly in panels that will be protected in service by finish or overlays. Synthetic patching materials (SPM) are now recognized as being suitable for the repair of larger defects in place of previously used wood inlays. These synthetic patching materials (SPM), under the influence of heat or catalysis, undergo an irreversible chemical reaction. They may contain organic and/or inorganic extender materials and pigments. Performance characteristics and durability under service conditions are required to be comparable to, or to exceed, those of wood-inlay repairs.

Synthetic patching materials are intended for repair of natural defects, including knotholes up to 40 mm measured across the grain, and splits up to 25 mm wide. They are not intended to allow for the upgrading of panels by the repair of splits wider than 25 mm or of open areas greater than 40 mm measured across the grain, that were

present before hot-pressing, except for occasional dropped machine patches. The deleterious effects of such defects on pressure transfer within a panel can lead to poor quality bonds in adjacent plies.

The following procedures have been prepared by Forintek's Western Laboratory and are recommended for the evaluation of synthetic patching materials.

EVALUATION PROCEDURES

SPM repairs are evaluated by the tests described below. Specimens prepared under normal mill conditions, in accordance with the procedure anticipated in production, shall be provided by the applicant to Forintek's Western Laboratory or an independent testing agency approved by the laboratory. In all cases, the performance is to be judged against that of a wood inlay or an approved SPM used to fill defects of comparable size. The wood-inlay-comparisons specimens will be prepared by hot-press-gluing a patch in place with resorcinol-formaldehyde glue in a site prepared by routing to bare wood.

Tests are conducted on panels with filled defects of the maximum size permitted in the pertinent CSA Standard (0121M-1978, 0151M-1978). Repair materials are designed for use in one of four conditions:

- Where the natural glueline is present;
- Where the glueline has been lightly abraded;
- Where the glueline has been routed out to leave bare wood.
- Where wood is exposed from a core veneer having no glueline (i.e., face veneer knotholes, splits etc. occurring where a single glueline system is applied);

The applicant is to specify under which of these conditions the material is to be tested.

In order to ensure standardization of testing between agencies and to simplify communication, the following schedule of types and classes has been set up.

Class A - Knotholes Patched

- Type 1 - Panel face with 40-mm knothole, measured across the grain, that has been patched without preparation of the glueline with SPM.
- Type 2 - Panel face with 40-mm knothole, measured across the grain, with a glueline that has been lightly abraded and patched with SPM.

Type 3 - Panel face with 40-mm knothole, measured across the grain, from which the glueline has been routed to bare wood and patched with SPM.

Type 4 - Panel face with a 40-mm knothole, measured across the grain, that has a core veneer without glueline exposed and has been patched with SPM.

Comparison Specimen - Panel face with 40-mm knothole that has been routed to bare wood and patched with an approved SPM or with a wood inlay approximately 60 mm x 115 mm, glued in place by hot-pressing with a resorcinol-formaldehyde resin.

Class B - Splits Patched

Type 1 - Panel face with approximately 25 mm x 450 mm split that has been patched without preparation of the glueline with SPM.

Type 2 - Panel face with approximately 25 mm x 450 mm split where the glueline has been lightly abraded and patched with SPM.

Type 3 - Panel face with a split routed to approximately 25 mm x 450 mm of bare wood and patched with SPM.

Type 4 - Panel face with approximately 25 mm x 450 mm split that has a core veneer without glueline exposed that has been patched with SPM.

Comparison Specimen - Panel face with a split routed to approximately 40 mm x 450 mm of bare wood and patched with an approved SPM or with a 40-mm wood inlay glued in place by hot-pressing with a resorcinol-formaldehyde resin.

Class C - Routed Areas

Type 3 - Panel face with an allowed natural defect, or a manufacturing defect, routed out to approximately 60 mm x 180 mm in bare wood and patched with SPM.

Comparison Specimen - Panel face with an allowed natural defect or manufacturing defect, routed out to approximately 60 mm x 180 mm in bare wood and repaired with an approved SPM or with a wood inlay glued in place by hot-pressing with a resorcinol-formaldehyde resin. Test and comparison specimens are to be manufactured to

be 300 mm x 300 mm except as otherwise required by the test procedures. A suitable number of comparison specimens will be furnished by the testing agency and tested beside the test specimens. If convenient to do so, the comparison repair may be inset into the test specimen.

TEST METHODS

1. Boil and Dry Test

a) Specimen preparation

Prepare, for each type of each class to be evaluated, two specimens 300 mm x 300 mm with no edge sealing or protective coating.

b) Test procedure

Subject specimens to two cycles of four hours immersion in boiling water, followed by 20 hours of drying in a high-circulation oven at $63^{\circ}\text{C} \pm 3^{\circ}\text{C}$. After final drying and cooling to room temperature, cut with a power saw through the repairs and inspect the bonds.

2. Soak and Dry Test

a) Specimen preparation

Prepare, for each type of each class to be evaluated, two specimens 300 mm x 300 mm with no edge sealing or protective coating.

b) Test procedure

Subject specimens to ten cycles, each to consist of four hours immersion in water at room temperature ($21^{\circ}\text{C} \pm 3^{\circ}\text{C}$), followed by a minimum of eight hours of drying in a high-circulation oven at $63^{\circ}\text{C} \pm 3^{\circ}\text{C}$. After final drying and cooling to room temperature, cut with a power saw through the repairs and inspect the bonds.

3. Accelerated Weathering

a) Specimen preparation

For each type of each class to be evaluated, prepare two 67 mm x 150 mm specimens for each of the finishing systems

described below. The repair shall be centered between the long edges. Knot repairs shall be located approximately on the center line between the two short sides. Finish the upper half of the specimen, leaving the lower half unfinished. Apply the following finishes by brush:

- i) One coat of exterior, acrylic-latex house paint over one coat of companion non-staining exterior primer.
- ii) One coat of exterior, light-coloured, semi-transparent oil stain.
- iii) One coat of exterior, light-coloured, semi-transparent acrylic-latex stain.
- iv) Two liberal applications of a paintable, water-repellant preservative.
- v) Re-apply top coat at equivalent one-year exposure period.

b) Test procedure

Expose specimens in a light-and-water-exposure apparatus similar to that described in ASTM recommended Practice G23-69. Operate the machine with continuous light and intermittent water spray, with a spray cycle of 18 minutes, followed by 102 minutes dry exposure, cycle repeated continuously. Continue exposure for at least 700 hours or for machine-time equivalent of two years outdoor exposure, based on equipment manufacturer's equivalency rating. After exposure, examine specimens for performance of repairs in weathering and their ability to hold finishes.

4. Outdoor Weathering

a) Specimen preparation

For each type of each class to be evaluated, prepare two 300 mm x 300 mm specimens for each of the finishing systems described below. Apply each finish to cover the upper half of each repair and the adjacent panel surface and leave the bottom half unfinished. Apply the following finishes by brush:

- i) One coat of exterior, acrylic-latex house paint over one coat of companion non-staining exterior primer.
- ii) One coat of exterior, light-coloured, semi-transparent oil stain.
- iii) One coat of exterior, light-coloured, semi-transparent acrylic-latex stain.

- iv) Two liberal applications of a paintable, water-repellant preservative.
- v) Re-apply top coat at equivalent one-year exposure period.

b) Test procedure

Expose specimens outdoors on an ASTM exposure rack, oriented at 45° from the vertical and facing due south. Examine periodically and at end of test period for performance of repairs in weathering and their ability to hold finishes.

5. Resistance to Concrete-Forming Chemicals

a) Specimen preparation

For each type of each class to be evaluated, prepare four 300 mm x 300 mm specimens with the defect approximately centered in the specimen.

b) Test procedure

Expose two specimens each to the following chemical solutions by floating with repaired face down:

- i) In 100-pale oil or equivalent form-release agent for a period of three days.
- ii) In pH-10 sodium-hydroxide solution for a period of three days.

Blot dry the specimens after exposure and examine repairs for retention of bond, softening and overall integrity.

6. Compatability with Floorcovering Adhesives

a) Specimen preparation

For each type of each class to be evaluated, prepare two 300 mm x 300 mm specimens with the defect approximately centered in the specimen.

b) Test procedure

Apply to each specimen a vinyl floor tile using a latex-based cement. After 24 hours observe in low angle light for signs of depression in the tile.

7. Bending

a) Specimen preparation

For each type of each class to be evaluated, prepare two specimens approximately 75 mm x 600 mm and not over 9.5 mm thick with face grain direction parallel to the long dimension. Repairs shall be centered between the two long sides.

b) Test procedure

Bend specimens over a mandrel having a radius equal to that of the minimum bending radius for the plywood thickness being tested. Orient specimens with the repair on the outer or tension surface. Bending radii are as follows: 6 mm plywood - 1200 mm radius; 8 mm plywood - 1500 mm radius; 9.5 mm plywood - 2100 mm radius. Examine repair for its ability to stay in place and remain crack free.

8. Machining

a) Specimen preparation

For each type of each class to be evaluated, prepare two specimens approximately 300 mm x 300 mm for each machining test. Follow good shop practice and use tools that are in good condition.

b) Test procedures

i) Sawing

Cut through the center of the defect once in the direction of the larger axis using a table saw and once at right angles to the first cut. The repaired side shall be up.

ii) Nailing

Drive bright-box nails (38 x 2 mm approx.) through the panel in the repaired area from the face side. Use two nails for each Class A repair, four for each Class B repair, and six for each Class C repair. Back the specimen solidly during nailing.

iii) Drilling

Power drill with a 7 mm diameter machine bit through the repaired area from the re-repaired face. Drill one hole in each Class A repair, two in each Class B repair, and four in each Class C repair.

iv) Routing

Power rout a 12 mm groove through the repaired area to the approximate depth of the first glueline. The routing line shall be cut along the longest axis of the repair.

v) Sanding

Power-sand the specimen over the repaired area with 60-grit paper.

For each type of machining, examine specimens for the ability of repairs to be machined satisfactorily.

9. Impact

a) Specimen preparation

For each type of each class to be evaluated, prepare two 300 mm x 300 mm specimens using 9.5 mm or thinner plywood. The repair shall be located approximately at the center of each specimen.

b) Test procedures

Secure a specimen, with the repair facing down, to a square frame which firmly supports the panel on all four edges but which leaves at least a 250 x 250 mm area unsupported. Drop a 550 gm steel ball on the upper face of the specimen opposite the repair from heights of 900, 1200, 1500 and 1800 mm, successively, with one drop from each height. Examine the repair for its ability to stay in place.

10. Overlay Test

a) Specimen preparation

For each type of each class to be evaluated, prepare four 300 mm x 300 mm specimens using 14 mm or thicker plywood. Hot-press to the repaired side of each of two specimens High Density Overlay as described in Section 4.2.1.2 of CSA Standard 0151M-1978. Hot-press to the repaired side of each of the other two specimens Medium Density Overlay as described in Section 4.2.1.3 of CSA Standard 0151M-1978 and/or CSA Standard 0121M-1978.

b) Test procedure

Subject all four specimens to the boil-and-dry test (Test Methods). Examine the overlay surface in low-angle light for distortions in the repair region.

EVALUATION CRITERIA

After the various test procedures have been carried out by Forintek's Western Laboratory, or by an approved independent testing agency, evaluation will be carried out by Western Laboratory staff.

In all tests, the performance of each synthetic patching material repair shall be compared to that of a wood inlay or an approved SPM used to patch a similar size defect, with respect to ability to stay in place, to resist cracking and to receive and hold finishes or overlays. A material that shows performance at least equivalent to that of the wood inlay or the approved SPM used in each and every test would be considered equivalent to the wood-inlay system for suitability for patching plywood panels.

Outdoor-exposure fence data are not necessary for original evaluation of the material, but unsatisfactory performance within the two-year outdoor exposure would be considered to be evidence that the material is not equivalent to a wood-inlay system for suitability for patching plywood panels.

ACKNOWLEDGEMENT

This report draws heavily on the background work carried out by the American Plywood Association which is the basis for their report "Approval Procedures and Requirements for Synthetic Repairs in Product Standard PS1 for Softwood Plywood, Construction and Industrial". Permission to do so is gratefully acknowledged.